ATTACHMENT (4)

FLAW EVALUATION CALCULATION

Purpose:

This calculation is intended to demonstrate that the pin hole found in 4" HC-23-1005 will not have any impact on the structural integrity of the line with regard to reinforcement of the pipe section. This calculation does not check global loads (e.g., pipe stresses), these loads have been evaluated via Calc. 95-0135.

Inputs:

1) The piping configuration is as shown on SK-M-608 sh 10.
2) The pipe dimensions are as follows:

4" sch 10s pipe.	
OD	4.5"
Thickness	0.120"

3) The material is permitted to be either A-312 or A-376 TP 304. This evaluation is insensitive to any differences between these two materials specifications.
4) The piping is seamless pipe with a joint efficiency factor of 1.0
5) The Code of Record for this piping is B31.7 Cl 2 1969 with 1971 addenda

Assumptions:

The indication is similar to an unreinforced circular opening. This is based on the PT and UT results. There was no sign of linear or planar type indication. Furthermore, the indication is too small to represent a volumetric defect at this time. Use of the LEFM methodology outlined in GL 90-05 would not yield meaningful results with the geometry and defect characterization. Therefore, it is appropriate to utilize branch reinforcement rules to bound the defect in a gross manner.

Methodology:

The impact of the defect on the local section will be shown to be of no local structural consequence using area reinforcement rules from the original construction Code. Other evaluations of this degraded condition have checked piping stress levels and found that they were well below Code allowable. This evaluation is limited to local hoop effects only.

The reinforcement for a 1" hole will be checked to demonstrate that it has no impact on the required section strength with regard to hoop stress. The indication that has been observed is too small to measure directly but, is much smaller than 1". It could be approximated at 1/16 to 1/32". Furthermore, the indication is thought to be caused by a "burn-through" during original construction. The stainless steel material is not susceptible to degradation due to any type of corrosion at this location which would cause this open to enlarge.

The calculation is shown on the next page.

Conclusions:

By virtue of gross size difference between the 1" opening and the actual opening, it is clear that there is no impact on the section integrity. In addition, there will be continued monitoring of the line such that if a measurable change in the indication size or characteristics occurs, the gross margin contained herein will ensure no challenge to the structural integrity will occur prior to identification.

Unreinforced opening evaluation of B31.1 104.3.1 (1992 ed)
Note: B31.7 1969 ed. w/ 1972 add. refers to B31.1
Evaluation of t_{mh} *(Required min wall)*:

$$t_{mh} = \frac{P \cdot D_o}{2 \cdot (SE + P \cdot y)} + A$$

P	200	Design Pressure (psi)
Do	4.5	Outside diameter (in)
SE	17800	Allowable Stress (psi)
y	0.4	Coefficient for ferritic steel
Life	*24*	*Service life (months)*
rate	*0*	*Corrosion Rate (in/yr)*
A	0	Corrosion allowance (in)

$t_{m.h}$ 0.03 Required min wall IAW Eqn (3) 104.1.2 (in)

Evaluation of Reinforcment Requirements

The required reinforcement is:

$$A_7 = t_{mh} \cdot d_1$$

t_{mh}	0.03	Required min wall IAW Eqn (3) 104.1.2 (in)
d1	1	Assumed size of an un-reinforced opening

A7 0.03 Required reinforcement area (in^2)

Area available for reinforcement

$$A_1 + A_2 + A_3 + A_4 + A_5 \geq A_7$$

$$A_1 = (2 \cdot d_2 - d_1) \cdot (T_h - t_{mh})$$

tb	0	Thickness of branch (in)	
A	0	Corrosion allowance (in)	
Th	0.12	Actual wall in header (in)	
d2'	0.62	(in)	(tb-A)+Th +d1/2
d2"	1	(in)	d1

d2 is the greater of d1 or (tb-A)+Th +d1/2

d2	1	half width reinforcing zone (in)

A1 0.09 area provided by excess run wall (in)

In this instance A2 through A5 are zero since the branch connection is assumed to fail

Excess reinforcement

A1-A7 0.07 Therefore this is acceptable.

ASME / ANSI B31.1 (1967) CODE COMPLIANCE

Point name	Load combination	In-Pl. Moment (Moments in ft-lb)	Out-Pl. Moment	Torsion Moment	S.I.F In	S.I.F Out	Eq. no.	Load type	Code Stress (Stress in psi)	Code Allow.
70 F+	Max P							HOOP	4286	15600
	GR + Max P	0	32	0	1.00	1.00		SUST	1946	15600
	Cold to T1	0	15	0	1.00	1.00	(8)	DISP	104	27275
	Sus. + R1	27	166	79	1.00	1.00		OCC	3024	18720
	Sus. + R2	41	268	119	1.00	1.00		OCC	3766	28080
75	Max P							HOOP	4286	15600
	GR + Max P	0	4	0	1.00	1.00		SUST	1756	15600
	Cold to T1	0	42	0	1.00	1.00	(8)	DISP	289	27275
	Sus. + R1	159	365	79	1.00	1.00		OCC	4497	18720
	Sus. + R2	240	658	119	1.00	1.00		OCC	6566	28080

*** Segment A end ***

STRESS LEVELS AT ANCHOR No. 37.

CALC. NO. 95-135 R/0
ATTACHMENT. B
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